BAFFLE FOR DEEP FRYER HEAT EXCHANGER

INTRODUCTION

The present invention relates to a deep fryer, and more particularly, to an improved baffle for a deep fryer heat exchanger.

BACKGROUND OF THE INVENTION

Deep fryers are commercially used by restaurants, institutional kitchens, and fast food establishments for cooking a variety of food products, such as french fries, fish, fried chicken, and the like. The food product is cooked by totally immersing it within a vat or tank that is filled with heated oil or shortening. The oil may be heated using a flow of heated gas that is forced or drawn through a heat exchanger having flow passages that are located within or external to the cooking vat. A gas burner is provided to heat the gas circulating within the heat exchanger. Baffles, such as spiral baffles and disc baffles, have been known to be provided within the flow passages of heat exchangers to increase the turbulent flow of gas and enhance heat transfer.

It is an object of the present invention to provide a baffle for a deep fryer which reduces or wholly overcomes some or all of the difficulties inherent in prior known devices. Particular objects and advantages of the invention will be apparent to those skilled in the art, that is, those who are knowledgeable or experienced in this field of technology, in view of the following disclosure of the invention and detailed description of certain preferred embodiments.

SUMMARY OF THE INVENTION

The principles of the invention may be used to advantage to provide a baffle for the heat exchanger of a fryer system which can improve the heat transfer from heated gas flowing through heat transfer conduits of the heat exchanger to shortening contained within a vat.

In accordance with a first aspect, a heat exchanger for a fryer system has at least one heat transfer conduit having a heating fluid passing therethrough. A baffle plate is disposed within the at least one heat transfer conduit and defines a plane. The baffle plate has a first surface, an opposed second surface, and a longitudinal axis dividing the baffle plate into a first portion and a second portion. Each of a plurality of tabs has a longitudinal axis and extends outwardly away from one of the first and second surfaces. The intersection of the tab and the baffle plate defines a crease. At least one of the tabs is positioned in the first portion of the baffle plate and at least one of the tabs is positioned in the second portion of the baffle plate. A plurality of webs are provided with each web separating a tab from other tabs adjacent in a direction substantially perpendicular to the longitudinal axis of the tab.

In accordance with another aspect, a baffle for a heat exchanger has at least one heat transfer conduit with a heating fluid passing therethrough. A baffle plate is positioned in the at least one heat transfer conduit and defines a plane. The baffle plate has a first surface, an opposed second surface, and a longitudinal axis dividing the baffle plate into a first portion and a second portion. Each tab of a plurality of rows of tabs is formed of a portion of the baffle plate bent outwardly from one of the first and second surfaces. Each tab has a longitudinal axis, and defines a crease along an intersection of the tab and the baffle plate. At least one tab in each row is positioned in the first portion of the baffle plate, and at least one tab in each row is positioned in the second portion of the baffle plate. Each row has the crease of all of its tabs form an acute angle with one of a portion of a longitudinal edge of the baffle plate which is upstream, with respect to the flow of heating fluid, of the main body of its respective tab and a portion of the longitudinal edge which is downstream, with respect to the flow of heating fluid of the main body of its respective tab. The rows adjacent to the each row have the crease of all of their tabs form an acute angle with the other of a portion of a longitudinal edge of the baffle plate which is upstream, with respect to the flow of heating fluid, of the main body of its respective tab and a portion of the longitudinal edge which is downstream, with respect to the flow of heating fluid, of the main body of its respective tab. Each web of a plurality of webs separates a tab from another tab adjacent the tab in a direction substantially perpendicular to the longitudinal axis of the tab. The crease of at least one tab is directly downstream, with respect to the flow of heating fluid, of the web between two other tabs which are adjacent and upstream of the at least one tab. The number of tabs per unit length increases along the baffle plate in a downstream direction with respect to the flow of heating fluid.

From the foregoing disclosure, it will be readily apparent to those skilled in the art, that is, those who are knowledgeable or experienced in this area of technology, that the present invention provides a significant technological advance. Preferred embodiments of the baffle for a deep fryer heat exchanger can provide increased turbulence and enhanced heat transfer within the flow passages of the heat exchanger. These and additional features and advantages of the invention disclosed here will be further understood from the following detailed disclosure of certain preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Certain preferred embodiments are described in detail below with reference to the appended drawings wherein:

FIG. **1** is a schematic perspective view of a gas fryer containing a heat exchanger according to the present invention;

FIG. **2** is a schematic perspective view of the heat exchanger shown in FIG. **1**;

FIG. **3** is a schematic perspective view of a baffle according to the present invention;

FIG. **4** is a schematic section view, showing the baffle of FIG. **3** placed within a heat transfer tube of FIG. **2**;

FIG. **5** is a schematic plan view, shown in section, of a plurality of baffles placed within a heat transfer tube of FIG. **2**;

FIGS. **6–9** are schematic elevation views illustrating various embodiments of the baffle of FIG. **3**;

FIG. **10** is a schematic plan view, shown in section, of an alternative embodiment of the baffle of FIG. **5**; and

FIG. **11** is a schematic perspective view of the perimeter plate of FIG. **10**.

The figures referred to above are not drawn necessarily to scale and should be understood to present a representation of the invention, illustrative of the principles involved. Some features of the baffle depicted in the drawings have been enlarged or distorted relative to others to facilitate explanation and understanding. The same reference numbers are used in the drawings for similar or identical components and features shown in various alternative embodiments. Baffles, as disclosed herein, will have configurations and compo-

nents determined, in part, by the intended application and environment in which they are used.

DETAILED DESCRIPTION OF CERTAIN PREFERRED EMBODIMENTS

Referring to FIG. **1**, a gas fryer according to the present invention is shown generally by reference numeral **10**. The gas fryer preferably includes a plurality of vats **12** for holding the shortening, oil, or other cooking medium, a heat exchanger **14** for heating the shortening in each vat **12**, a burner section **11** for heating the fluid flowing through heat exchanger **14**, and may include a blower motor in blower housing **13** for drawing the heated fluid through heat exchanger **14**. Due to its efficiency and economic availability, the heat exchange fluid generally used in the present invention and in prior art gas fryers is air; however, other gaseous fluids or liquids may of course also be considered as the development thereof permits. In the preferred embodiment of FIG. **2**, heat exchanger **14** includes a plurality of heat transfer conduits or tubes **16, 18, 20, 22, 24, 26, 28, 30** and two mixing plenums **32, 34**. The direction of travel of the heated fluid through heat exchanger **14** is schematically illustrated in FIG. **2** to show the heated fluid entering the vat through inlet heat transfer tubes **16, 18, 20**, mixing in plenum **32**, passing through heat transfer tubes **22, 24, 26**, mixing in plenum **34**, and then exiting the vat through outlet heat transfer tubes **28, 30**. In a preferred embodiment of the present invention, gas fryer **10** includes a vat **12** having internal dimensions of 20"×20", 18"×18", or 14"×14", although any other desired dimensions could also be used. Heat exchanger **14** is therefore correspondingly sized to be disposed within vat **12**. A further description of the heat exchanger is provided in U.S. Pat. Nos. 5,417,202 and 5,706,717, assigned on their faces to America's Favorite Chicken Company (AFC), the entire contents of which are hereby incorporated by reference.

A baffle plate **40** having a longitudinal axis L is shown in FIG. **3**. Plate **40** has a plurality of tabs **42** extending outwardly from each of first surface **43** and second surface **45** of plate **40**. Tabs **42** preferably extend outwardly at an acute angle with respect to the surface from which they extend. More preferably, tabs **42** extend outwardly at an angle of 45° with respect to the surface from which they extend. Each tab **42** has a longitudinal axis A which is perpendicular to crease **44**. In a preferred embodiment, each tab **42** is formed by cutting plate **40** and bending a portion of plate **40** outwardly, forming crease **44** at the joint where tab **42** is bent away from plate **40**. Although tabs **42** may be formed by securing separate pieces of material to plate **40**, such as by welding, in which case crease **44** would extend along the line of intersection of tab **42** and plate **40**, forming tabs **42** by bending a portion of plate **40** outwardly removes the welds as a potential point of failure of plate **40**. Web **46** is the portion of plate **40** which remains between tabs **42** adjacent to one another in a direction substantially perpendicular to longitudinal axis A. In the embodiment illustrated in FIG. **3**, where the planes of first surface **43** and second surface **45** lie in a vertical plane, web **46** is between two vertically adjacent tabs **42**. It is to be appreciated that plate **40** may be oriented in a different manner and that web **46** would lie between adjacent tabs in a direction other than vertical. It is also to be appreciated that tabs **42** may have a shape other than the substantially rectangular shape shown in FIG. **2**, e.g., circular, oval, or any other suitable shape which will become obvious to those skilled in the art given the benefit of this disclosure.

As seen in FIG. **4**, plate **40** is positioned in heat transfer tube **16**. Although the discussion that follows deals primarily with heat transfer tube **16**, it is to be appreciated that a plate **40** may also be placed in some, or all, of the remaining heat transfer tubes **18, 20, 22, 24, 26, 28, 30**. Plate **40** is oriented within heat transfer tube **16** such that its longitudinal axis L (not shown here as it extends into the paper) extends substantially parallel to a longitudinal axis of heat transfer tube **16** and the direction of flow of heated air through heat transfer tube **16**. As the heated air flows through heat transfer tube **16** it is deflected by tabs **42**, increasing the turbulence of the flow within heat transfer tube **16**, illustrated by the arrows B shown in FIG. **3**. The increased turbulence in heat transfer tube **16** thereby enhances the heat transfer from the heated air, through heat transfer tube **16**, to the shortening in the vat. Plate **40** is preferably resting within heat transfer tube **16** as opposed to being secured thereto, such as by welding, in order to reduce the stresses on heat transfer tube **16**. In the embodiment illustrated in FIG. **4**, heat transfer tube **16** has an oblong, or obround cross section. It is to be noted that heat transfer tube **16** may have a circular cross section, or any other suitably shaped cross section.

As illustrated in the embodiment shown in FIG. **3**, plate **40** is oriented such that the leading edge of each tab **42**, that is, the edge that is upstream with respect to the flow of heated air through heat transfer tube **16** (flowing into the paper as seen in FIG. **3**), is the outermost edge of tab **42** with respect to plate **40**. Correspondingly, in this embodiment, the trailing edge of each tab **42**, that is, the edge that is downstream with respect to the flow of heated air through heat transfer tube **16**, is crease **44** where tab **42** joins plate **40**. Conversely, plate **40** may be oriented so that its leading and trailing edges are reversed, that is, the leading edge will be crease **44** and the trailing edge will be the outermost edge of tab **42** with respect to plate **40**. In either orientation, the outwardly extending tabs **42** serve to deflect the heated air flowing through heat transfer tube **16** increasing turbulence and enhancing heat transfer. Thus, crease **44** of each tab **42** is one of upstream or downstream, with respect to the flow of heating fluid, of the main body of its tab **42**. In certain preferred embodiments plate **40** may have one or more tabs **42** oriented such that their leading edge is crease **44** and one or more tabs oriented such that their trailing edge is crease **44**.

In certain preferred embodiments, a firebox (not shown) housing the flame produced by the burning gas is provided in burner section **11**. In other preferred embodiments, there is no firebox and the flame extends directly into a single heat transfer tube **16**, preferably having a circular cross section. In embodiments without a firebox, tabs **42** of plates **40** enable more complete combustion by causing better mixing of the gas and air within the single heat transfer tube **16**. Additionally, where three or more plates **40** are positioned within heat transfer tube **16**, the centermost plates, which reach higher temperatures since they are further from the lower temperature shortening contained in the vat, can improve combustion by reheating cool air which is introduced to the mixture. Tabs **42** and plates **40** can also increase heat transfer through radiation. Such an embodiment is shown in FIG. **5**, where a plurality of plates **40** are placed in heat transfer tube **16**. Plates are preferably secured to one another by cross members **48**. The number and placement and size of tabs **42** associated with each plate **40** can vary, depending on the flow characteristics that are desired for that particular heat transfer tube. For example, in the case where heated air is flowing from left to right in the embodiment illustrated in FIG. **5**, tabs **42** are oriented in such a manner to direct the heated air primarily from the center towards the walls of heat transfer tube **16** to improve heat transfer at the